

A.2.19 HIGH POWER INSTRUMENTS FOR PLANETARY EXPLORATION

1. Scope of Program

The High Power Instruments for Planetary Exploration (HPIPE) program supports the development of spacecraft-based instrument technologies that require input power levels far greater than has heretofore been possible in NASA's Solar System Exploration (SSE) program, which are expected to enable the execution of new classes of unique scientific investigations on future missions. The goal of this program is not to develop flight-qualified hardware, but rather to define and develop scientific instruments to the point where the instruments can be proposed in response to future SSE announcements of flight opportunity without additional extensive technology development. Therefore, the proposed instrument technologies must address specific scientific objectives of at least one candidate future SSE mission of either the proposer's own choosing and description, or one based on one of the examples in Section 2.2 below. New measurement concepts may be proposed, as well as methods to improve significantly the performance of existing instruments. For the purposes of this solicitation, it can be assumed that these missions will employ nuclear electric power and propulsion (NEPP) as described in Section 2.1 below.

The primary goal of this NRA is to promote the development of a new generation of scientific instruments for planetary exploration that can take advantage of the electrical power and data transmission rate that will be available on SSE missions using NEPP. For the purposes of this solicitation, assume that the following resources will be available to be shared among all instruments: electrical power in the range of 10-100 kW, return data rate in the range 10-100 Megabits/sec, and total mass up to 500 kg.

This level of available resources may make it possible to adapt current Earth science instruments for exploration of other planets in the solar system. An unprioritized and nonexclusive list of examples of instruments that would be appropriate for this solicitation include:

- Synthetic Aperture Radar (SAR);
- Orbiting subsurface-profiling radar;
- Orbiting magnetospheric radio sounder;
- High-power tunable laser spectrometer;
- Laser ablation spectrometer;
- Beamed power to instruments on planetary surface;
- Imaging polarimeter; and
- Multiaperture hyperspectral imager.

In addition, modifications of existing instruments designed for either past or near-term low power space missions that would significantly improve their performance through a greatly increased power and/or data rate may also be proposed. Therefore, proposals for

instruments characterized by Technology Readiness Levels (TRL's; see Appendix E.11 of the Office of Space Science Management Handbook at <http://spacescience.nasa.gov/admin/pubs/handbook/OSSHandbook.pdf> for definition of TRL's) from low to moderately high are appropriate for this program.

Proposals not appropriate for this HPIPE solicitation are those that seek to develop laboratory instruments, ground-based or airborne telescopes, auxiliary instrumentation such as spectrometers for telescopes, onboard data processing or data compression studies, or any space technology that is not directly related to science instrumentation.

Since the specific purpose of this program is to stimulate the development of instruments that can take advantage of the high power levels and relatively high data rates expected to be available on an NEPP mission, only proposals for instruments that are enabled by power levels and/or data rates greater than those available in previous planetary missions will be considered for selection. In addition, all proposals submitted to HPIPE must specify:

- The mission or class of missions for which the proposed instrument may be applicable (see Section 2.2 below; note that proposals of merit for instruments that may be suitable for a variety of missions will be given priority for selection over those applicable to only a single mission);
- The science objectives of the proposed instrument, where the relationship between the science objectives and the instrumental capabilities must be clearly described in the proposal (note that for those instruments applicable to many missions or capable of meeting multiple science objectives, examples of science objectives for the proposed mission or missions must also be given); and
- The TRL of the proposed instrument.

2. Background

2.1. Project Prometheus

NASA's newly defined Project Prometheus will develop the means to efficiently increase power for spacecraft, thereby fundamentally increasing the capability for Solar System exploration. Increased power for spacecraft means not only traveling farther or faster, but it also means exploring more efficiently with enormously greater scientific return. High levels of sustained power would permit a new era of outer Solar System missions designed for agility, longevity, flexibility, and comprehensive scientific exploration. There are two basic types of technology under consideration for Project Prometheus: radioisotope- and nuclear fission-based systems. Only fission-based systems are applicable to the HPIPE program.

Nuclear fission power and propulsion research will focus on developing the nuclear systems needed for revolutionary new capabilities in space exploration and provide the power for the instruments developed under this HPIPE program. Project Prometheus will

include research on reactors, advanced heat-to-power conversion, and power management and distribution technologies to provide spacecraft flexibility, long-mission durations, and orders of magnitude more power for science instruments.

Project Prometheus not only focuses on defining the near-term technology research goals, but has also identified planetary science missions that will be uniquely enabled by nuclear fission electric power and propulsion: the Jupiter Icy Moons Orbiter. The Jupiter Icy Moons Orbiter will be an ambitious mission to orbit three planet-sized moons of Jupiter - Callisto, Ganymede and Europa - which may harbor vast oceans beneath their icy surfaces. This mission would orbit each of these moons for extensive investigations of their makeup, their history, and their potential for sustaining life. There are other missions under consideration as well, see Section 2.2.

2.2. Examples of Possible HPIPE Missions

Nonprioritized examples of planetary missions that might be enabled by NEPP and this HPIPE program include, but are not limited to:

- A Galilean Satellite Tour that would successively orbit Callisto, Ganymede, and Europa, including the delivery one or more landers to Europa or another satellite;
- A Neptune Orbiter to perform a detailed exploration of both Neptune and Triton, as well as several Kuiper Belt Objects;
- A Titan Explorer that would build on the results of the Cassini/Huygens mission by performing a detailed exploration of Titan;
- A Venus Sample Return Mission; and
- A Mars Deep Drilling mission.

3. Programmatic Information

3.1 Nature of Awards

All activities selected under this HPIPE program will be funded solely through multiyear contracts having a base “Phase 1” period of performance of one year and Phases 2 and 3 that provide for up to two following option years. The total proposed period of performance may not exceed three years. Therefore, proposals for efforts greater than one year must be structured with a one year initial period with options for extension in time increments not to exceed one year each. Proposals should cover all phases for which the proposer intends to compete under this NRA since additional proposals for years 2 and 3 will not be solicited in the future.

Proposals must define clearly measurable milestones (a minimum of two per year). Steady progress toward reaching the milestones in a timely manner needs to be demonstrated in order to justify continuation of funding beyond the first year. *Annual*

Progress Reports will be required that describe progress toward these milestones no later than 60 days in advance of the anniversary date of the award.

Funding approval for the subsequent year(s) will be based on achievements toward milestones for the prior year as described in the *Annual Progress Report*, the continued program need for the investigation, and available funds. There is no guarantee that any options will be funded for the remaining performance timeframe.

The following budget information is tentative and is provided for planning purposes only. Any award will be subject to the availability of funds and to the outcome of appropriate peer review evaluations. The anticipated budget for this technology research program for FY 2003 is expected to be \$5M, with similar amounts in each of the succeeding two years. This profile is expected to fund approximately 10-15 investigations.

3.2 Schedule of Solicitation

The schedule for proposals for this opportunity is:

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| - Release Date | June 2, 2003 |
| - Notice of Intent to Propose Due Date | July 15, 2003 |
| - Proposal Due Date | September 2, 2003 |

3.3 Evaluation Criteria

The evaluation criteria contained in [Appendix C](#), Section C.2, of the NASA [Guidebook for Proposers](#), which is accessible by opening URL <http://research.hq.nasa.gov/>, shall be used to evaluate submitted proposals.

3.4 Program Overlap

Currently, the Planetary Instrument Definition and Development (PIDDP) program (Appendix A.2.11 in this NRA), also supports instrument development for potential future space flight to planets, but it requires instrumentation to be low power. Therefore, proposals for development of high power instruments should be submitted only to this HPIPE program. NASA reserves the right to resolve any overlap of proposals submitted to PIDDP and HPIPE program at the programmatic level at the time of selections. Proposers should be aware that each of these programs has different constraints, and proposals appropriate to one may not be appropriate to the other.

3.5 Instructions for Proposal Preparation and Submission

As discussed in the *Summary of Solicitation* of this NRA, the Office of Space Science (OSS) is now using a single, unified set of instructions for the preparation and submission of proposals. This material is contained in the document entitled *NASA Guidebook for Proposers Responding to NASA Research Announcement – 2003* (or *NASA Guidebook*

for Proposers for short) that is accessible by opening URL <http://research.hq.nasa.gov>, and linking through the menu item "Helpful References," or may be directly accessed online at URL <http://www.hq.nasa.gov/office/procurement/nraguidebook/>. This NRA's *Summary of Solicitation* also contains the instructions for the electronic submission of a *Notice of Intent* (NOI) to propose and a proposal's *Cover Page/Proposal Summary/Budget Summary*, and the mailing address for the submission of a proposal.

Questions about this program may be directed to the Program Officer:

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